

Exhibit 3 – U.S. Army Range Safety Manual

Department of the Army  
Pamphlet 385-63

Safety

# Range Safety

Headquarters  
Department of the Army  
Washington, DC  
10 April 2003

**UNCLASSIFIED**

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By Order of the Secretary of the Army:

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**Proponent and exception authority.**

The Chief of Staff, Army, is the Army proponent. The proponent has the authority to approve exceptions to this pamphlet consistent with controlling law and regulation. The proponent has delegated approval authority to the Director of Army Safety.

**Suggested improvements.** Army users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications

and Blank Forms) directly to the Director of Army Safety, Office of the Chief of Staff, DACS-SF, 200 Army Pentagon, Washington, DC 20310-0200. Marine Corps users will submit comments and suggestions for improvements to the Commanding General, Marine Corps Combat Development Command (C46R), 3300 Russell Road, Quantico, VA 22134-5001.

**Distribution.** This publication is available to Army users in electronic media only and is intended for command levels A, B, C, D, and E for the Active Army, the Army National Guard of the United States, and the U.S. Army Reserve. Publication and distribution to authorized users for Marine Corps commands are indicated in the Table of Allowances for Publications.

**History.** This is a new Department of the Army pamphlet.

**Summary.** The Army and Marine Corps will use this pamphlet in conjunction with Army Regulation 385-63/Marine Corps Order 3570.1B, to establish and maintain a comprehensive range safety program.

**Applicability.** The standards and procedures in this pamphlet apply to all personnel and range operations and activities on

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## Chapter 1 Introduction

### 1-1. Purpose

This pamphlet provides implementation guidance for the Army and Marine Corps (MC) Range Safety Programs prescribed in Army Regulation (AR) 385-63 and Marine Corps Order (MCO) 3570.1B. It provides standards and procedures for the safe firing of ammunition, demolitions, lasers, guided missiles, and rockets for training, target practice, and, to the extent practicable, combat.

### 1-2. References

Required and related publications and prescribed and referenced forms are listed in appendix A.

### 1-3. Explanation of abbreviations and terms

Abbreviations and special terms used in this pamphlet are explained in the glossary.

### 1-4. Applicability

a. This pamphlet applies to—

(1) The Active Army, United States Military Academy, the Army National Guard of the United States, U.S. Army Reserve, Department of the Army civilian employees, and contractors.

(2) Army Reserve Officers Training Corps during range or firing activities located on or within the jurisdiction of a military installation.

(3) Marine Corps commands active and reserve, unless the standards or procedures conflict with Department of the Navy or Headquarters, Marine Corps (HQMC) orders. Local standing operating procedures (SOP) and range policies will reinforce this pamphlet and AR 385-63/MCO 3570.1B.

(4) Range training and target practice activities.

(5) Military real estate areas that are being or have been used as bombing ranges, artillery impact areas, target areas, and other areas exposed to contamination by military munitions, chemicals, pyrotechnics, or other dangerous materials.

(6) All areas designated for live-fire weapons firing and laser training, including recreational ranges, located on Army- or Marine Corps-controlled property.

(7) Civilian training complexes when authorized for Army or Marine Corps active and reserve use.

b. The standards and procedures of this pamphlet are advisory for actual combat conditions.

c. This pamphlet also applies to training outside U.S. territories. U.S. Army or Marine Corps installation commanders will apply the provisions of this pamphlet or host nation agreements as appropriate.

d. Surface danger zones (SDZs) in this pamphlet represent minimum safety requirements. They are adequate only when employed with properly functioning safety equipment and devices and when trained and competent personnel follow published firing procedures.

e. Except for airspace and water traffic safety requirements, the standards and procedures in this pamphlet do not apply to development, proof and function test ranges, and laboratories. However, major Army commands (MACOMs) that have such ranges and laboratories are required to develop and apply alternate standards that are appropriate to the mission and to ensure the preservation of life and property. To ensure range safety measures are adequate for protecting equipment and personnel, development, proof and function test ranges, and laboratories are required to submit an adjusted SDZ and base justification of adjusted SDZ on risk-mitigating measures, failure mode and effects analysis, inspection and test procedures (for example, x ray or functional component validation), analytical data (for example, Monte Carlo and Six Degrees of Freedom simulations), and empirical data from the same missile or missile with similar flight characteristics. The applicable activity commander will approve the adjusted SDZ.

### 1-5. Deviations

a. Deviations may be granted based on critical mission requirements that conflict with regulatory standards in accordance with AR 385-63/MCO 3570.1B. Deviations are limited to—

(1) Reducing SDZ dimensions when terrain, artificial barriers, or other compensating factors make smaller SDZs safe.

(2) Modifying prescribed firing procedures appropriate for a state of training of participating personnel to increase training realism.

(3) Allowing personnel who are not directly participating in the actual conduct of training within the SDZ.

b. Deviations applied to SDZs extending beyond installation boundaries must be based on the ability to contain projectiles, hazardous fragments, laser beams and both vertical and horizontal ricochet sufficiently within the installation boundaries, and areas under military control (for example, leased land or training areas and facilities acquired through Memorandum of Understanding or Memorandum of Agreement.) Probability of hazardous fragment escape must not present a greater hazard than 1:1,000,000 ( $10^{-6}$ ) (unlikely) to the public.

c. As a minimum, all deviation authorizations will contain the following, as appropriate:

## **Appendix B**

### **Bat Wing Surface Danger Zones**

#### **B-1. Firing conditions**

SDZs in this appendix provide for greater containment of all ricochets. They should be considered when designing ranges that involve fire and movement, or where ricochet hazards outside the range complex boundary may endanger nonparticipating personnel, or the general public. Where bat wing SDZs have already been applied or can be employed without significant impact on range operations, the bat wing SDZs should be implemented.

#### **B-2. Surface danger zone**

*a.* Figure B-1 depicts the SDZ for small arms, machine guns, shotguns, and other direct fire weapons without explosive projectiles, firing from a single firing position along the GTL to a single target.

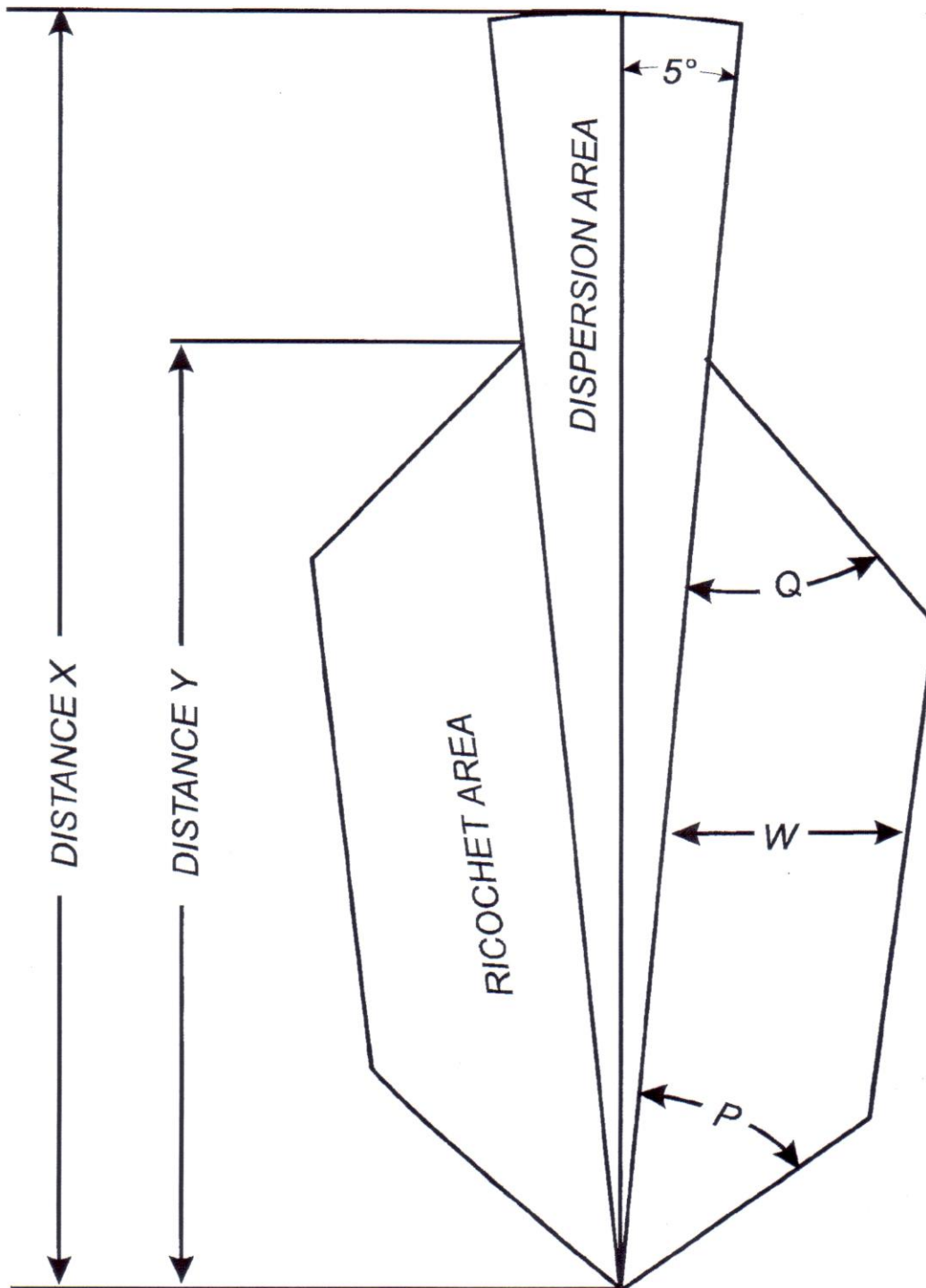


Figure B-1. SDZ for direct-fire weapons without explosive projectiles



c. When the nature or extent of training requires multiple firing positions, bisect the GTL longitudinally and expand the GTL to accommodate multiple targets. This establishes left and right limits of fire.

d. When the nature or extent of training requires moving targets, bisect the GTL longitudinally and expand the GTL to accommodate moving targets. This establishes left and right limits of fire.

e. Table B-1 provides SDZ dimensions with corresponding deflection values (area  $W$ , angles  $P$  and  $Q$ ) for engaging various target media, earth, water, steel, or concrete for small arms, machine guns, shotguns, and other direct fire weapons without explosive projectiles.

**Table B-1**  
**SDZs for direct-fire weapons without explosive projectiles**

Caliber	Impact media	Distance X	Distance Y	Area W	Vertical Hazard	Angle P	Angle Q
		(in meters)				(in degrees)	
12 gage Slug	Earth/water	1,073	710	125	136	21.96	33.34
	Steel/concrete	1,073	830	287	197	56.91	40.17
.22 caliber Long rifle, M24	Earth/water	1,400	1,033	155	96	24.00	15.90
	Steel/concrete	1,400	1,125	386	245	63.40	30.30
.38 caliber M41 Ball	Earth/water	1,806	1,110	153	89	22.57	16.07
	Steel/concrete	1,806	1,258	389	245	60.95	35.36
9 mm M882, ball	Earth/water	1,800	1,077	158	93	23.10	15.80
	Steel/concrete	1,800	1,211	399	253	61.10	30.40
.45 caliber M1911 Pistol/SMG	Earth/water	1,690	1,016	117	100	21.11	16.69
	Steel/concrete	1,690	1,111	290	186	54.74	30.77
5.56 mm M193 Ball	Earth/water	3,100	2,004	458	319	35.20	23.10
	Steel/concrete	3,100	1,666	323	219	19.00	26.90
5.56 mm M196 Tracer	Earth/water	3,100	2,066	362	355	35.10	26.80
	Steel/concrete	3,100	2,023	243	243	19.20	22.80
5.56 mm M855 Ball	Earth/water	3,437	2,029	462	325	34.20	22.40
	Steel/concrete	3,437	1,810	334	229	18.80	25.20
5.56 mm M856 Tracer	Earth/water	3,089	1,607	355	261	32.80	23.20
	Steel/concrete	3,089	1,592	277	261	18.60	21.00
5.56 mm M862 Plastic	Earth/water	250	165	24	16	15.40	20.00
	Steel/concrete	250	136	5	4	3.30	7.30
7.62 mm M118 Special	Earth/water	5,288	4,800	1,545	752	43.81	38.73
	Steel/concrete	5,288	5,137	990	490	20.17	41.29
7.62 mm M80 Ball	Earth/water	4,100	4,073	1,461	706	43.54	38.90
	Steel/concrete	4,100	4,053	861	447	20.04	75.54
.50 caliber M858 Ball, plastic	Earth/water	700	398	20	41	4.28	9.16
	Steel/concrete	700	415	53	41	11.65	21.14
.50 caliber M860 Tracer, plastic	Earth/water	700	398	20	41	4.28	9.16
	Steel/concrete	700	415	53	41	11.65	21.14
.50 caliber M2 AP	Earth/water	6,100	5,142	1,659	904	40.80	69.60
	Steel/concrete	6,100	4,300	718	462	16.30	33.10
.50 caliber M2 Ball	Earth/water	6,500	5,211	1652	901	38.19	63.35
	Steel/concrete	6,500	4,147	714	478	16.03	44.13
20 mm M220 TP-T	Earth	3,940	3,340	581	317	25.83	22.83
	Water	3,940	3,040	558	311	26.08	30.96
	Steel	3,940	3,290	804	513	36.66	47.76
	Concrete	3,940	3,260	765	447	34.33	34.09
20 mm M55A2 TP	Earth	4,500	3,780	733	357	25.74	33.20
	Water	4,500	3,500	737	350	26.16	36.66
	Steel	4,500	4,053	1,025	585	38.14	36.82
	Concrete	4,500	3,750	969	509	34.12	37.78

## **Appendix C**

### **Surface Danger Zone Design**

#### **C-1. Description**

*a.* SDZs for direct- and indirect-fire weapons, as determined by test methods and computer simulation systems, have similar parameters or components. Their size and shape vary, because of performance characteristics of the weapon system and ammunition models. Figures C-1 and C-2 illustrate direct- and indirect-fire SDZs, respectively. Descriptions of the SDZ parameters or components are in the glossary, section II, terms.



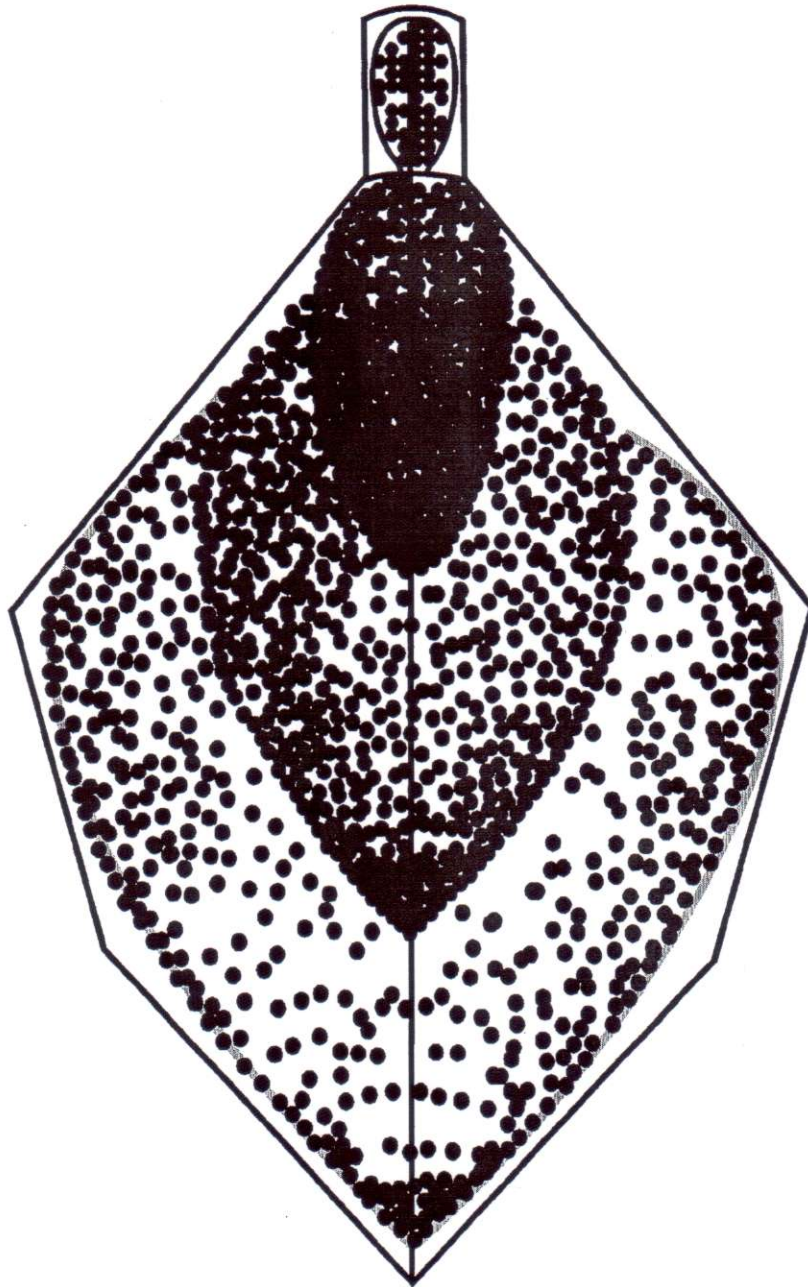


Figure C-3. Ballistic footprint and associated SDZ

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c. Lateral SDZ requirements are generally greater at shorter ranges because of higher projectile velocities. As the target range increases, projectile velocity decreases; this generally results in a narrower SDZ further down range. Projectiles impact more perpendicular to the earth as the quadrant elevation increases. Lateral ricochets diminish significantly at quadrant elevations above 15 degrees.

d. Unique weapon systems contained in this pamphlet require special SDZs (for example, MLRS, TOW, Patriot, and Improved Hawk). The parameters or components of these special SDZs are similar to those listed above, however, the manner in which the SDZs are constructed is different. This pamphlet describes the construction of the special SDZs for these unique weapon systems.

## C-2. Basic SDZs

a. The basis for construction of any SDZ is fundamental. All SDZs, regardless of complexity, are drawn from a point or points of reference. With a fundamental understanding of the need for, and basis of, SDZs, and this pamphlet, users will be able to construct any SDZ. It is imperative to use this pamphlet as a reference in constructing all SDZs.

b. To construct an accurate and precise SDZ, users will need the following equipment as a minimum: compass, protractor, plotting scale, and fine point pencil. Dimensions of SDZ parameters (for example, angles  $P$  and  $Q$ , areas  $A$  and  $B$ ) are given in the respective table for each weapon system. Draw lines lightly in pencil, at first, so unnecessary construction lines can be erased more easily; then go back and darken the lines that define the SDZ.

c. The procedure outlined below is one way to construct an SDZ. It is suitable for SDZs that are based on current test methods and computer simulation models.

(1) Determine the firing position and the target position. Draw a straight line from the firing position through the target position to the required distance  $X$  (plus the additional distance requirement for area  $B$ , if applicable). This establishes the GTL (missile target line, rocket target line, and so forth). Place a tic mark on the GTL at distance  $X$  (include area  $B$ , if applicable) for future reference. (See figure C-4.)

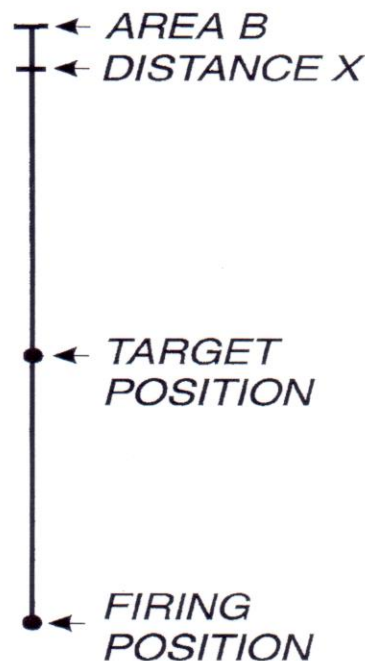


Figure C-4. Gun target line

(2) At the firing position, measure out to the left and right of the GTL, with a protractor, the required degrees to establish the dispersion area; place tic marks. Draw a straight line from the firing position through each tic mark out to distance  $X$ . (See figure C-5.)

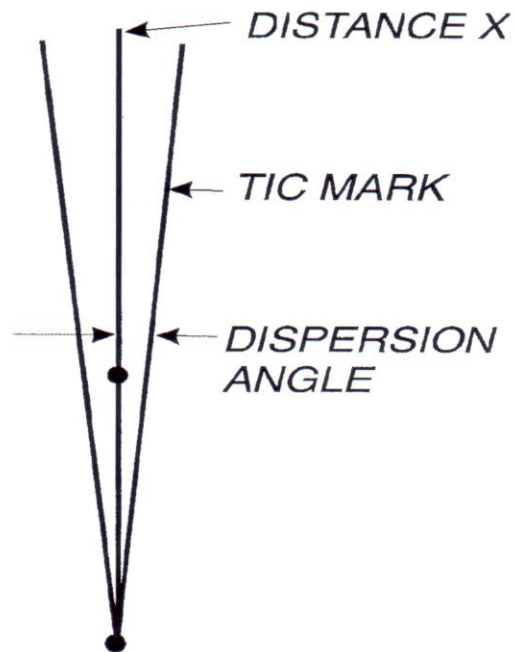


Figure C-5. Dispersion area angles

(3) From the firing position, scribe an arc between the left and right limits of the dispersion area (i.e., the lines constructed in (2) above), with a compass, using distance  $X$  as the radius. This completes the dispersion area. (See figure C-6.)

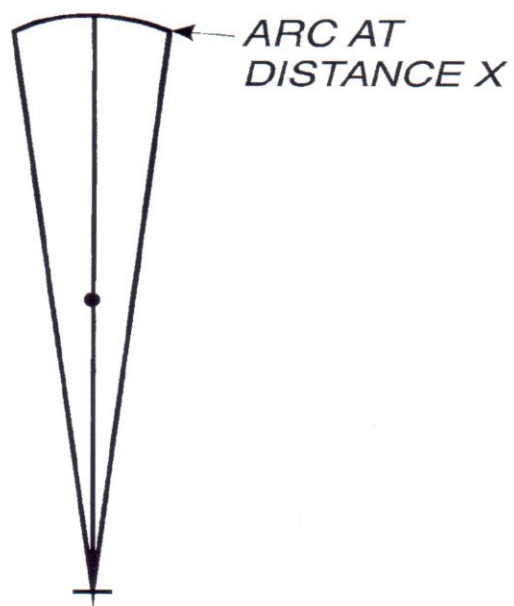


Figure C-6. Dispersion area

(4) Place a tic mark at distance  $Y$  along the left and right limit of the dispersion area for future reference. (See figure C-7.)

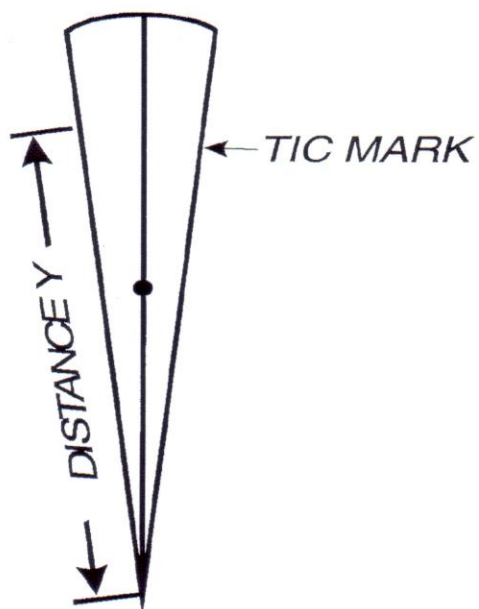


Figure C-7. Tic marks for distance  $Y$



(5) At the firing position, using a protractor, measure from the left and right limits of the dispersion area determined above, the required degrees for ricochet area, angle  $P$ ; place tic marks. Draw a straight line from the firing position through the tic marks. Next, at distance  $Y$ , measure with a protractor, from the left and right limits of the dispersion area, back toward the firing position with a protractor the required degrees for ricochet area, angle  $Q$ ; place tic marks. Draw a straight line from the tic marks at distance  $Y$  (step 4, above) through the tic marks just drawn. (See figure C-8.)

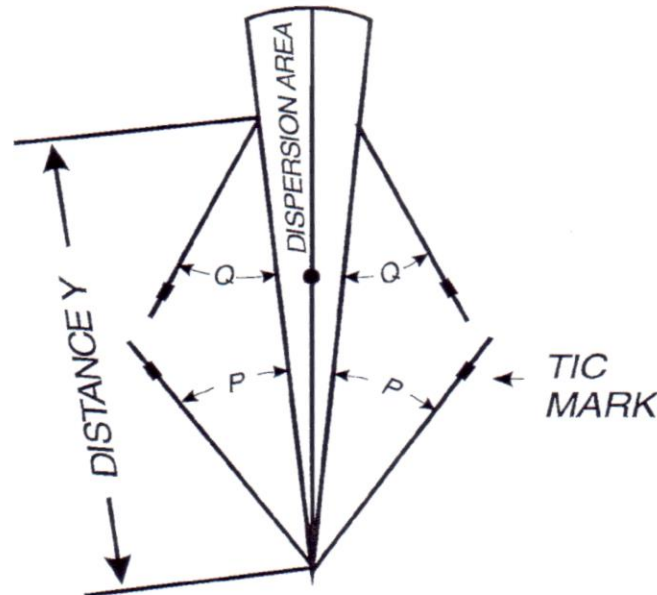
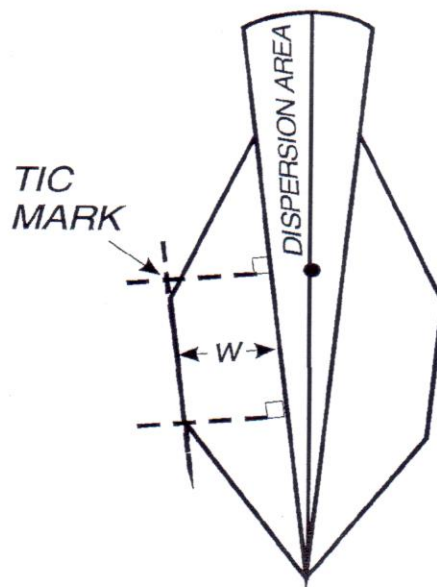


Figure C-8. Addition of angles  $P$  and  $Q$

(6) At two locations, measure perpendicular from the left and right limits of the dispersion area the required distance for area  $W$  and place tic marks. Draw a straight line through the tic marks to intersect the lines previously drawn for angles  $P$  and  $Q$ . This completes the ricochet area. (See figure C-9.)

Figure C-9. Completion of area *W*

(7) If areas *A* and *B* are required, draw these areas parallel to the dispersion area and ricochet area. Measure perpendicular at two locations along the perimeter of the dispersion area and ricochet area, place a tic mark. Next, connect the tic marks with straight lines until they intersect the  $25^\circ$  angle constructed to the outside of the angle *P* line. This completes area *A*. Plot the value of area *B* at the down range end of the beyond distance *X* and scribe an arc between the area *A* boundaries. This completes area *B*. (See figure C-10.)